study this Rockefeller report advantageously. An acceptance of its standards and methods would result in an elimination of some of the vagaries and egotisms which the directors of one or two other foundations seem unable to keep in the background. It would be well for all foundations, massive or otherwise, to keep in mind that man's world has been existing many hundreds of years, and that cultural and welfare developments have not been confined to recent times. Further, that in things closely associated with the daily lives of human beings, something more than revolutionary academic or report dissertations are necessary before the world can be changed.

This truth applies particularly to activities related to medicine, in which such amazing progress has been made in the last half century under a system which some lay theorists are insistent shall be changed to suit their views. Wherefore, as already stated, the 1935 report of the Rockefeller Foundation should be of interest to all medical men. At the next visit to your medical library, ask for the volume. It is well worth a careful inspection.

Other State Association and Component County Society News.—Additional news concerning the activities and work of the California Medical Association and its component county medical societies is printed in this issue, commencing on page 287.

EDITORIAL COMMENT†

THE TECHNIQUE OF ELECTROCARDIOGRAPHY*

It had been known since 1856 that the contraction of the heart resulted in the production of an electrical current, but not until 1887 did Waller demonstrate that this current could be led off from the surface of the body and recorded. Einthoven, in 1904, was the first to perfect an instrument sufficiently sensitive to accurately follow the small, rapidly-varying heart currents, and apparatus to record them.

The earlier instruments were string galvanometers, the sensitive element being a very fine gold-plated quartz fiber suspended between the poles of a powerful electromagnet. Here the heart current, without modification, passes directly through the string and results in the deflection. Lately, instruments using vacuum tubes have been developed which greatly amplify the action current and pass it through the string of a relatively insensitive galvanometer, carrying a small mirror. Here the deflection of a reflected beam of light is photographed. In the string instruments it is the shadow of the string itself which is photographed.

The advantages and disadvantages of the two types of instruments are relative and minor. The string instruments must be more carefully handled, are operated preferably from batteries, are more easily shielded from alternating current interference, and give slightly higher complexes, mostly in the R and T waves, although it is not proven that this is a more accurate picture than that obtained with tube instruments, and the difference is usually slight. The vacuum tube instruments are more portable, usually may be run from 110-volt alternating current lines (ordinary house current), but give more trouble from A. C. baseline interference, and are more prone to have mechanical difficulties. One prime difference is the fact that the skin resistance of the patient has no effect on the vacuum type. In the string instrument it must be compensated for.

Whatever type instrument is used for the actual recording of the electrocardiogram, there are certain precautions to be observed in the preparation of the patient and the actual taking of the picture.

Preparation of Patient.—1. The patient, when he is first informed of the desirability of obtaining an electrocardiogram, should be told that the activity of his heart produces the deflection and there is no possibility of his receiving an electrical shock. This is conducive to mental rest and physical relaxation on the part of the patient, and also results in a much smoother base line on the cardiogram.

2. The patient should be given a slip by his doctor (if forms are not supplied) to take to the cardiographer, giving the age, clinical diagnosis and details as to treatment with digitalis, as minimum information necessary. These facts are of distinct aid to the cardiographer in his interpretation, since his function is more to correlate findings or suggest possibilities than to make a diagnosis (except for disturbances of rhythm).

Technique.—1. The essential conditions are to have the patient in a prone position and at rest. Dyspneic patients should be propped up with sufficient pillows to prevent respiratory embarrassment, as an absolutely horizontal position is not necessary. Just before each lead is taken, the patient should be cautioned to be absolutely quiet, but may be allowed to move or talk at other times.

2. Proper electrical connection of the patient to the apparatus must be made. The skin where the contact is to be made should be scrubbed vigorously with a towel dipped in warm salt solution. The gauze is then soaked in this solution, wrapped about the limb, and the electrode applied tightly over it. These precautions lower skin resistance and prevent skin current.

3. Lead IV connections are made by placing the right arm electrode on the anterior chest wall over the fourth left interspace, just to the left of the sternum. The left arm electrode is placed on the posterior chest wall directly opposite the other electrode. The patient is kept in the semirecum-

† This department of CALIFORNIA AND WESTERN MEDICINE presents editorial comment by contributing members on items of medical progress, science and practice, and on topics from recent medical books or journals. An invitation is extended to all members of the California Medical Association to submit brief editorial discussions suitable for publication in this department. No presentation should be over five hundred words in length.

* Articles in the Editorial Comment department in this issue, and marked with a †, belong to a series of nine papers read before a recent meeting of the San Francisco Heart Association. The series will appear in this column in succeeding numbers of CALIFORNIA AND WESTERN MEDICINE.

bent position on his left side while the lead is being taken. Lead V is the same, except that the posterior electrode is attached to the left leg. Many other variants have been described, all giving essentially the same cardiographic picture.

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INTERPRETATION OF ELECTROCARDIOGRAMS

Within recent years clinical electrocardiography has come to be more generally used, and it is accepted as an important aid in the diagnosis of cardiac disease. However, its limitations are well recognized by cardiologists. Severe heart disease may not be accompanied by electrocardiographic abnormality and, conversely, definite abnormalities frequently are not inconsistent with good cardiac function. The evaluation of the electrocardiogram, therefore, should always be made in the light of careful clinical examination, and caution should be exercised in the interpretation of electrocardiographic changes.

The electrocardiograph is frequently of great value in clarifying the presence of various arrhythmias. It is sometimes impossible, for example, to distinguish clinically between auricular fibrillation, premature auricular beats and multiple extrasystoles, and similarly, the paroxysmal tachycardias, without its aid.

The presence of myocardial disease is often disclosed when not detectable clinically. It is practically impossible to diagnose latent heart block without electrocardiographic evidence, and this is frequently so with bundle-branch or I-V block. In coronary thrombosis the tracings are often characteristic, but not always necessary to diagnose the condition clinically; on the other hand, in doubtful cases of angina pectoris, typical changes may serve to substantiate the diagnosis definitely.

The electrocardiograph may be of considerable help in the therapeutic management of the cardiac patient, and particularly in detecting the toxic effects of digitalis on the myocardium prior to their clinical manifestations. It furnishes very little information, however, concerning the presence of valvular or congenital heart disease, and then only indirectly.

To estimate accurately the significance of abnormalities in the electrocardiogram, it is essential to know certain physiological principles in regard to the origin and spread of action currents in the normal heart, and likewise to appreciate the variation in appearance and time relation that may normally occur in the complexes. The following are some of the more important criteria employed in the interpretation of electrocardiographic tracings at the University of California Hospital:

NORMAL FIGURES:

Rate 60 to 100 min.

P.R. interval—0.20 sec. or less in lead in which it is longest.

Q.R.S. interval—0.10 sec. or less in lead in which it is longest.

Axis deviation—

Right—The main deflection of Q.R.S.$_1$ is down and of Q.R.S.$_3$ is up.

Left—The main deflection of Q.R.S.$_1$ is up and of Q.R.S.$_3$ is down.

Voltage of Q.R.S. complex—usually over 10 mm. in lead showing the highest voltage. Deflections under 5 mm. in all leads are definitely abnormal.

Voltage of T wave—Over 1 mm.

CRITERIA OF BUNDLE-BRANCH BLOCK:

Q.R.S. interval over 0.10 sec.

Q.R.S. complex slurred or notched.

A definite axis deviation with the T wave in opposite direction from main Q.R.S. deflection (sometimes in opposite direction from the slurred limb of the Q.R.S. deflection).

FUNCTIONAL DISTURBANCES GENERALLY ASSOCIATED WITH MYOCARDIAL DAMAGE:

In the conduction system:

Prolongation of P.R. or Q.R.S. interval (especially in the case of bundle-branch block).

Definite slurring or notching of Q.R.S. complexes in two leads.

In the muscle:

Low or inverted T waves (in leads other than III, and providing effects of drugs are ruled out).

Usually in the case of certain abnormal rhythms, such as auricular fibrillation and flutter and ventricular tachycardia.

Marked deviations of R.T. or S.T. interval from the base line.

Deep Q$_3$ (over 25 per cent of height of largest Q.R.S. deflection).

CRITERIA FOR NORMAL LEAD IV (OR V):

P wave small, diphasic or inverted.

Q.R.S. complex diphasic with deep Q wave.

S.T. interval short, sloping into an inverted T wave.

CRITERIA FOR ABNORMAL LEAD IV (OR V):

(*a*) T wave:

1. A positive T wave.
2. A disphasic T wave taller than 2 mm.
3. A shallow broad negative T wave less than ¼ mm. high.
4. A negative T wave deeper than 9 mm.

(*b*) S.T. segment:

1. A positive S.T. segment.
2. A negative S.T. segment more than 2 mm.
3. Any negative S.T. deviation when associated with a positive T wave.

(*c*) Q.R.S. complex:

1. Slurred or notched.
2. Monophasic (absent Q wave).

Any one is considered abnormal, but a combination is of more significance.

Limited space will not permit a complete discussion and illustrations of the differentiation of arrhythmias and the more recent knowledge of evidences of myocardial damage; hence, the reader is referred to the literature on the subject.

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Wisdom consists in knowing what to do. Skill consists in knowing how to do it. Virtue consists in doing.—David Starr Jordan.